Title: Did school finance equalization increase revenue instability for school districts?

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Abstract Body

Background / Context: *Description of prior research and its intellectual context.*

      This study uses an Interrupted Time Series analysis with a non-equivalent comparison group to estimate the causal effect of school finance equalization on district revenue instability. I apply a microeconomic framework to an understudied problem in education finance and policy. In so doing, I illustrate how policies can sometimes create unintended consequences that stay with districts for multiple years.

      Recent news headlines detailing budget gaps and possible school closings call attention to the current fiscal crisis facing school districts. I argue that today's revenue shortfalls are a symptom of a longer-term phenomenon of uncertain, fluctuating revenues facing school districts. Such revenue instability matters to the extent it may truncate policy reform and implementation before it can come to fruition, exacerbating so-called "policy churn" (Hess 1998; Stone, Henig, Jones, & Pierannunzi, 2001). School district officials describe how unpredictable revenues may hamper districts from effectively planning and implementing future policy or program improvements. A once-ambitious reading improvement program may be shrunk to a meager set of supplementary texts. In addition, uncertain revenues may lead to erratic spending, making it difficult for districts to fulfill instructional plans or even make consistent purchases. In districts where teacher retention is a problem, such stops and starts could undermine retention efforts, hurting continuity required for student achievement.[i]

      To date, we have little evidence about the *causes* of *district* revenue instability in order to test whether the above scenario of consequences plays out for all school districts. I turn to prior literature on tax (revenue) stability and school finance to motivate this study. While tax stability studies do not address the impact on the education sector, school finance literature tends not to examine revenue stability within a given district over time. One can infer that state revenue instability matters for districts, but the literature does not sufficiently address this link.

      Tax stability studies provide consistent empirical evidence that property taxes are more stable, while income and sales taxes are more volatile (Sobel & Holcombe 1996; Poterba 1994; Dye and McGuire 1991). Edgerton et al. (2004), in a case study of New York City's budget crisis, emphasize that revenue structures that rely heavily on personal income taxes produce excess fluctuations, or instability beyond what budget officers could predict. Yet the shift toward more volatile income and sales taxes is precisely what many state school finance systems adopted in pursuit of finance equalization. Despite the recent crash in property values in some locales, the property tax base for a county or state is likely still fluctuating less than the sales and income tax base, especially over a 10- or 30-year time span (Vasche &Williams 2005).

      Although such tax studies typically treat revenue instability as a state-level phenomenon, school districts are a vital unit of analysis. Districts mediate state policy, through instructional programs to fulfill state standards, and they steward the bulk of state education revenues. In addition, many districts face practical or policy limitations on raising local revenues, so their budget constraint is often a direct function of state revenue conditions—if state revenues contract, a district's per-pupil revenues will likely contract as well.

      Thus, to examine district revenue instability, I need to identify a mechanism that could affect not just district revenue levels, but rather revenue fluctuations. Given the tax literature's attention to volatile tax bases and revenue streams, I focus on a policy that changed the tax base for education to an extent that might have increased revenue fluctuations: finance equalization.

Purpose / Objective / Research Question / Focus of Study: *Description of the focus of the research.*

      This study asks whether state finance equalization policies led to changes in long-term district revenue stability, not just immediate changes in per-pupil revenue levels. A number of studies assess the effect of state school finance reforms on district revenue and spending levels around the late 1980s and early 1990s, but not on long-term revenue stability (Card & Payne

2002; Downes & Shah 2006; Courant & Loeb, 1997; Hoxby 2001; Murray et al. 1998). For example, Card and Payne examine court-ordered and legislative school finance reform. They suggest that the change in state funding formulas leads to a change in the income slope of state aid (revenues) to districts, which leads to a change in the income slope of per capita district expenditures. They find that reforms that increased state aid to poorer districts increased spending in those districts, ultimately narrowing the spending gap as planned. However, an unexamined consequence may be revenue instability: state aid to districts tracks state budget declines, thereby exposing districts to state-level revenue fluctuations from a volatile tax base. The literature does not categorize reforms in terms of which districts may be harmed more by instability.

This study contributes to the literature in several ways. First, I apply analysis of revenue instability to the education sector. Second, I examine how instability in state education funding affects school districts. Third, I assess the long-term trend in revenue instability within a district over time, or how much fluctuation could not be predicted. Typically district-level studies compare districts at a point in time, not within-district changes over time.

While a district may have multiple possible sources of instability – which I define as the unpredictable component of revenue fluctuations – I focus on a source whose effect I can observe and estimate. Finance equalization policies, as I discuss further in the Intervention section, instigated a shift away from property taxes as the funding source toward income and sales tax revenues, which have proved more volatile over time. In addition, such policies were designed specifically to change or equalize per-pupil revenues at the *district* level, so it is sensible to examine their effect on district outcomes.

Setting: *Description of the research location.*

The setting is the United States in a period of policy change and shifting state revenue structures. From 1971-1990, multiple states faced challenges to their school finance schemes through the courts or the legislature (please insert Table B.1 here). From 1990 to the present, districts have faced more centralized state finance systems and changes in local voter preferences for funding education. In short, districts confronted decreased capacity to raise local revenues to combat any instability in state revenues.

Population: *Description of the participants in the study: who, how many, key features or characteristics.*

Though the intervention is a state-level variable, the outcome of interest is at the district level. Just as some curriculum reforms are adopted by states but implemented by districts, the finance reforms in this study are adopted by the state but experienced by the district, so I assess the revenue outcomes at the district level. This study draws on district-level data from 45 states and the independent districts for which data is available. I exclude states that do not have independent school districts, such as Maryland, since comparable data is not available for them going back to the early 1980s. I also exclude certain kinds of districts: i) charter districts, since such districts were not present at the beginning of the study, ii) special education districts, and iii) districts with fewer than 200 students, since some of them subsequently consolidated with larger districts, making long-term revenue instability patterns difficult to identify.

While many states experienced school finance reform, there are 13 states that adopted sales/income-tax funded equalization schemes. I identify these 13 states as the 'treatment' group, which represents roughly 4,500 districts. Remaining states, with roughly 5,000 districts, serve as the non-equivalent comparison group. The list of states is in Table B.1.

Intervention / Program / Practice:
Description of the intervention, program or practice, including details of administration and duration.

The policy intervention in question is state adoption of school finance equalization. I describe the policy reform, timing, and possible mechanisms for influencing instability. California and other states moved away in the 1980s from a strictly local assignment of property

tax revenues to local districts, opting instead for pooling property tax revenues for more equal allocation and redistribution to school districts throughout the state. In a so-called guaranteed tax base scheme, the state captures 'excess' revenues from wealthy districts, and contributes its share of spending in the form of the matching rate to districts. This rate is usually higher for poorer districts. This arrangement reduces the tax price of spending, or the amount of revenue the district must raise in order to spend one unit more, because the district does not bear the full burden of raising revenues. In addition, some states also decided that the primary revenue source for the education general fund would be income and sales taxes, potentially introducing volatility. While the various reforms intended to narrow the gap in revenues per pupil between rich and poor districts, they were not designed to even any *instability* in revenues either within or between districts. But if poor districts are experiencing more revenue instability, it may weaken efforts to equalize revenues.

Court-ordered reforms may be qualitatively different from legislative changes to school finance in terms of the timeline between decision and implementation, as well as in terms of the effect on district *spending* (Hoxby 2001; Downes & Shah 2006; Murray et al. 1998). One might be concerned about anticipation effects, such as districts changing program allocations or teacher contracts in advance of the new revenue base and distribution scheme. However, these adjustments occur on the spending side and not necessarily on the revenue side. And those adjustments would be a one-time event. This study is concerned with the more proximate revenue effects: whether the policy resulted in increased revenue instability at the district level that would not otherwise have arisen.

School finance reform could influence instability in two different ways. Finance equalization may be social insurance for poor districts and therefore *buffers* them from instability. Much as the state provides subsidized food assistance and health care to individuals in poverty, the redistribution of revenues through matching grants or other measures acts like income support for districts under duress. Beyond just leveling up or leveling down spending (Hoxby 2001), equalization policies may also operate as a cushion against shocks (just as unemployment insurance cushions against the shock of job loss). In this scenario, the state redistributes revenues among districts and may also absorb some of the burden of revenue shocks.

An alternate view is that finance equalization and the resulting centralization have curtailed local autonomy, and thereby *exacerbates* effects of state revenue instability. For instance, districts that rely more on local revenues may face more fluctuations but also have more options to raise local revenues to combat the volatility. But centralization through finance equalization has limited the extent to which some districts can raise local revenues, such as capping property tax rate increases or requiring supermajorities to pass parcel taxes. In effect, equalization has dampened local efforts that would otherwise allow districts flexibility to cope with instability.

Research Design: *Description of research design*

An interrupted time series (ITS) is well-suited to examine districts with repeated measures over time and that experience an intervention that continues into the future. ITS improves upon a simple difference-in-difference or regression discontinuity design by examining changes in slopes as well as intercepts, i.e. changes in revenue trends as well as levels. A key assumption for my study to satisfy ITS conditions is that in the absence of finance equalization, a district's revenue *trajectory* would not have changed significantly after the policy-adoption year. District revenues would have continued to fluctuate as they did prior to the policy. I design the study to evaluate whether the district revenue instability trend changes once a policy turns 'on' in a state. In Figure B.1 (please insert B.1 here), the pre-policy trend is in light bars and the post-policy trend is in dark bars. I use the 'pre' period as a counterfactual for the post-policy period. Each state adopts its policy change in a different year, so there is variation in the intervention timing, making it unlikely there is a single alternative mechanism driving a change in revenue

trends for all states (I elaborate in the Data Analysis section). To address concerns that the policy is not the only change in a given year, I also use states that did not adopt equalization reforms as a non-equivalent comparison group.

Data Collection and Analysis: *Description of the methods for collecting and analyzing data.*

To conduct the proposed analysis, I need a sufficiently large dataset to detect variation in revenues and spending across states and across districts within states. Because I conceptualize instability as an over-time phenomenon, I also need sufficient years of data to create a panel data structure to examine trends within a district and to ensure that any patterns I observe are more than just random error. I assemble several NCES administrative datasets[*] to create a panel of approximately 11,000 independent and dependent districts spanning 25 years. The panel I construct improves upon earlier school finance papers, which rely on the Census of Governments. Such data, from years ending in 0, 2 and 7, are not suited to assessing year-to-year shocks or instability trends over time.

First, I start with the Longitudinal School District Fiscal-Nonfiscal Detail File spanning FY1990-2002, with a record for each school district. The dataset does not contain more granular data on revenue sources, so I merge in local and state revenue-source variables from the annual datasets for this time frame available from the Common Core of Data. To this dataset, I increase the number of earlier years by adding revenue and operating expenditure variables from FY1970-1990 using the Historical Database on Individual Government Finances (IndFin). Finally, I increase the number of post-2002 years by merging annual data from the Local Education Agency Finance Survey (F-33) Data for FY2003 to the present. To this dataset of finance variables, I add student demographic information in order to assess the relationship between instability, spending and district characteristics. I use district-level student demographic information drawn from the Public Agency Universe datasets.

I exclude certain kinds of districts: i) charter districts, since such districts were not present at the beginning of the study, ii) special education districts, since they are receiving special types of funding and enrollment conditions, and iii) districts with fewer than 200 students, since some of them subsequently consolidated with larger districts, making long-term revenue instability patterns difficult to identify. All told, I have a district panel with demographic and fiscal characteristics consisting of 13,518 districts. For the analysis in part V, I focus on 12 states in my panel that adopted sales/income-tax reliant equalization schemes. This includes approximately 4,500 independent school districts over 30 years, which captures several waves of reforms.

To construct the annual instability measure, as well as the over-time trend, I consider the time-series nature of the data. Revenues tend to be serially correlated from year to year, so it is necessary to separate ongoing trends from fluctuations in revenues that represent excess variability. I purge these trends from the data before measuring revenue instability. To do so, I use a lagged dependent variables model. Growth in revenues is typically a more stationary outcome measure, and implicitly de-trends the data. Dickey-Fuller tests for the pooled sample confirm that growth is indeed a more stationary measure than levels.[†] I examine Durbin's alternative statistic for a random sample of districts to test for the number of lags that would remove serial correlation, and two lags seem to be sufficient. Not only do the test statistics identify a model that is stationary, but examining two years' of changes also approximates what a district with a limited amount of data might use to predict revenues for the upcoming fiscal year. While a district may not necessarily purge

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[*] Fiscal Data: Local Education Agency Finance survey (F-33), 1990-2008; Historical Database on Individual Government Finances (IndFin), 1970-1989; Demographic data: Public Agency Universe survey FY1987-2008. I check for continuity in reported revenues over time and adjust for inflation using the CPI-U.

[†] Dickey-Fuller tests for both trend and drift in a pooled sample showed that a model with variable levels as the outcome do contain a unit root. In the growth model, the model with drift behaves best. Even with a differences model, at least 6% of districts in the sample still have serial correlation, but this proportion is acceptable for a 95% confidence interval.

their data of serial correlation and trends, I am trying to isolate the component of variability that is least predictable and quantify that. As it turns out, that model is quite similar to what a district might use:

(1) $\Delta Revenues_t = \alpha_d + \beta_1(\Delta revenues)_{t-1} + \beta_2(\Delta revenues)_{t-2} + u_t$

Preliminary evidence suggests that a detrended revenue variable is stationary and lends itself to this type of decomposition. The residual captures the part of revenues that is *unpredictable* based on prior revenue streams and trends throughout the district. Thus, $\hat{u}_{dst}$ is the estimated instability measure, net of any association and trend.

      With this instability measure as the district-level outcome in each year, I use an ITS design to evaluate whether the slope of a district's revenue instability prior to policy reform changed after its state adopted equalization reforms. If all states adopted reforms in the same year, estimates of the policy change could be confounded with other nationwide changes in that year. But different states adopt reforms in different years. If I see similar patterns across districts and states regardless of adoption year, then it is likely that the policy (and not the year) is driving an observed change in slope. Though the policy reform year may be correlated with state characteristics, I am observing changes in the *district* instability slope. It is unlikely that any one district could manipulate the date or extent of the state policy reform to alter its trend. Thus, I can satisfy the ITS assumption that the pre-policy trend is a reasonable counterfactual for the post-policy trend in revenues. Finally, if one believes the literature on tax stability, then a shift to a sales/income tax-reliant base should be the primary driver of revenue instability (though many things could affect revenue levels). I include a parameter to account for an initial increase or decrease in revenue levels, which is analytically distinct from long-term revenue instability associated with the policy change.

      Taking the predicted instability measure discussed earlier as the outcome in each year, I examine repeated measures on districts within states (please insert Figure B.2 here). I center the policy adoption year to be zero for the respective state to allow for easy comparison of treatment effects across states. I use π_1 to capture the pre-post difference in intercepts from any bump or dip in revenues attributable to redistribution from the equalization formulae in the year immediately following the policy (this is expected change rather than instability). This accounts for an initial increase or decrease in revenue levels, and avoids confounding the initial change in revenue levels with the post-policy instability trend.

      The parameter of interest is π_2, which represents the change in the instability slope for districts after the state adopts the equalization policy or change in the tax base. I center the policy adoption year to be zero for the respective state to allow for easy comparison of treatment effects across states and to ensure that I do not confound a year effect with a policy effect. I allow the function f to be both linear and quadratic, and I interact the time trend and being in a treated state with an indicator for whether the district receives a high share of revenues from the state. About one-third of districts in the sample are in this category.

Findings / Results: *Description of the main findings with specific details.*

      Between treated and control states, revenue instability remains significantly different post-finance equalization. Although the trend in revenue instability declined after the policy was adopted, we see evidence of moderator effects. Districts in states that shifted their tax base for education toward sales and income taxes, and that received more than 60% of their revenues from the state, experienced an increase in revenue instability after finance equalization reform was adopted.

      In terms of change in instability before and after the policy, Figure B.4 demonstrates that if districts are heavily reliant on state funding, and the state shifts to a more volatile tax base, instability

increases after the policy is adopted (indicated by the green circle line). Even 10 years later, instability remains higher than the pre-policy trend, though instability does decline. Changing the tax base where districts are not so dependent on state funding has no significant effect on instability (blue diamond line), and we see no change for districts where the tax base went unchanged (indicated by the square and triangle markers). In terms of revenue instability levels, districts in a state that shifted its tax base (the top line) and which receive less than half of their revenues from the state experience the highest revenue instability of the four groups.

I test whether there is an interaction effect between change in the tax base and high reliance on state revenues, and find a significant interaction effect in a linear regression model with standard errors clustered at the district level. The model in Table 7 suggests that although instability is decreasing somewhat in the post-reform period, as the visualization suggests, districts with high state revenue shares in states with a change in tax base post-reform are more likely to experience variability in state revenues. Considering that the outcome is in standard deviation units, the .02 change is not trivial. The p-value on the joint F-test for adding the covariate confirms that the specification in column (3) is significantly different from other specifications.

Conclusions: *Description of conclusions, recommendations, and limitations based on findings.*

Despite mixed evidence on whether the *quantity* of per-pupil revenues and spending affect student achievement (Hanushek 2003; Hedges et al. 1994), we know little about whether *stability* of those revenues and spending matters. It is possible that the instability of revenues undermines efforts to narrow per-pupil revenue gaps or encourage additional spending by poor districts. Inasmuch as we care about finance inequality, we must understand revenue instability to evaluate the consequences of policies designed to reduce that inequality.

Appendices
Not included in page count.

Appendix A. References
References are to be in APA version 6 format.

Card, D., & Payne, A. A. (2002). School finance reform, the distribution of school spending, and the distribution of student test scores. *Journal of Public Economics, 83*(1), 49-82.

Chapman, J. I. (2003). Local Government Autonomy and Fiscal Stress: The Case of California Counties. *State & Local Government Review, 35*(1), 15-25.

Courant, P. N., & Loeb, S. (1997). Centralization of School Finance in Michigan. *Journal of Policy Analysis and Management, 16*(1), 114-136.

Downes, T. A., & Shah, M. P. (2006). The Effect of School Finance Reforms on the Level and Growth of Per-Pupil Expenditures. *Peabody Journal of Education, 81*(3), 1-38.

Dye, R. F., & McGuire, T. J. (1991). Growth and variability of state individual income and general sales taxes. *National Tax Journal, 44*(1), 55-66.

Edgerton, J., Haughwout, A., & Rosen, R. D. (2004). Revenue implications of New York City's tax system. *Current Issues in Economics and Finance, 10*(4).

Hanushek, E. A. (2003). The Failure of Input-based Schooling Policies. *The Economic Journal, 113*(485), F64-F98.

Hess, F. M. (1998). *Spinning wheels: The politics of urban school reform*. Washington, DC: Brookings Institution Press.

Hedges, L. V., Laine, R. D., & Greenwald, R. (1994). An Exchange: Part I: Does Money Matter? A Meta-Analysis of Studies of the Effects of Differential School Inputs on Student Outcomes. *Educational Researcher, 23*(3), 5-14.

Hightower, A. M., H. Mitani, et al. (2010). State Policies That Pay: A Survey of School Finance Policies and Outcomes. EPE Research Center. Bethesda, MD, Editorial Projects in Education.

Hoxby, C. M. (2001). All School Finance Equalizations Are Not Created Equal. *The Quarterly Journal of Economics, 116*(4), 1189.

Matthews, J. (2005). Tax Revenue Volatility and a Statewide Education Tax. *State Tax Notes 38*(4).

Murray, S. E. Evans, W. N. Schwab, R. M. (1998). "Education-Finance Reform and the Distribution of Education Resources," *American Economic Review* 88(4): 789-812.

Odden, A. & Picus, L. (2004). *School Finance: A Policy Perspective*. New York: McGraw Hill

Poterba, J. M. (1994). State Responses to Fiscal Crises: The Effects of Budgetary Institutions and Politics. *The Journal of Political Economy, 102*(4), 799-821.

Sobel, R. S., & Holcombe, R. G. (1996). Measuring the growth and variability of tax bases over the business cycle. *National Tax Journal, 49*, 535-552.

Stone, C., Henig, J., Jones, B., & Pierannunzi, C. (2001). *Building civic capacity: The politics of reforming urban schools*. Lawrence: University Press of Kansas.

Vasché, J. D., & Williams, B. (2005). Revenue Volatility in California. *State Tax Notes, 36*(1), 35-46.

Appendix B. Tables and Figures

The table below describes the dates of various school finance reforms in states, either due to pressure from voters or specific legislation and/or court cases. Some states experienced reforms more than once, due to repeated challenges. The reforms varied in scope, so I note the 13 states that changed how their education system was funded toward more of a sales or income tax base.
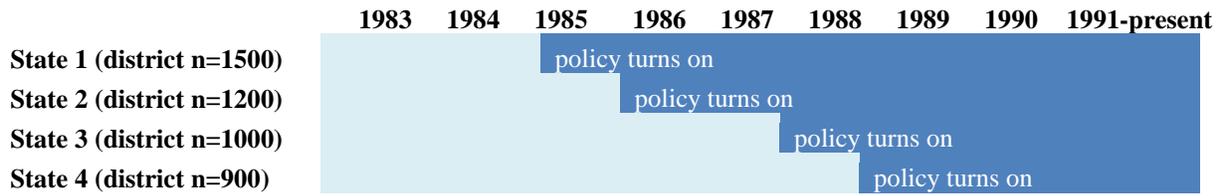
Table B.1. Dates of state school finance equalization reforms.

State	Legislative Reform	Court-Ordered Reform	Major changes in foundation tax rate and use of sales/income tax to fund education during reform era
Alabama		1993	
Arizona	1980	1994	X
Arkansas		1983	
California	1971, 1977	1978	X
Colorado	1973		
Connecticut		1978	X
Florida	1973		
Georgia	1986		
Idaho	1978		
Indiana			X
Iowa	1972		
Kentucky		1989	
Louisiana	1988		
Maine	1978		
Maryland	1987		
Massachusetts	1985	1993	X
Michigan	1994		X
Minnesota	1973	1993	
Missouri	1977	1993	
Montana		1989	X
New Hampshire	1985	1993	
New Jersey		1973, 1976, 1989, 1991, 1995	X
New Mexico	1974		
New York			X
N. Carolina			X
Oklahoma	1987		
Pennsylvania			X
Rhode Island	1985	1994	
S. Dakota	1986		
Tennessee	1977		
Texas	1984	1989	X
Vermont	1987		
Virginia	1975		X
Washington		1978, 1991	
W. Virginia		1979, 1988	

Sources: State categorizations based on Murray, Evans & Schwab (1998); Hoxby (2001); and Card & Payne (2002). Categorizations for 2008 from Hightower et al. (2010).
NB: I exclude Ohio, Illinois and Utah since their reforms occurred over several years and do not lend themselves to analysis of change at a discrete time point. I exclude Hawaii since the state is a single district.

Figure B.1. Data Structure

	1983	1984	1985	1986	1987	1988	1989	1990	1991-present
State 1 (district n=1500)			policy turns on						
State 2 (district n=1200)				policy turns on					
State 3 (district n=1000)						policy turns on			
State 4 (district n=900)							policy turns on		

The figure depicts how different states adopt equalization policies or turn 'on' their policies in different years. Of course, there is a tradeoff – the earlier a state adopts a finance reform, the less data I have to construct the pre-policy trend. Conversely, the later a state adopts its reform, the less data I have to construct the post-policy trend. The large sample of districts I have in each state provides sufficient variability.

Figure B.2. Empirical Specification of Interrupted Time Series with Non-Equivalent Comparison Group

$$\widehat{u_{dst}} = \pi_0 + f_d(t_{st} - t_s^*) + \pi_1 \text{Policy}_{st} + \pi_2[f_d(t_{st} - t_s^*) * \text{Policy}_{st}] + \varepsilon_{dst}$$
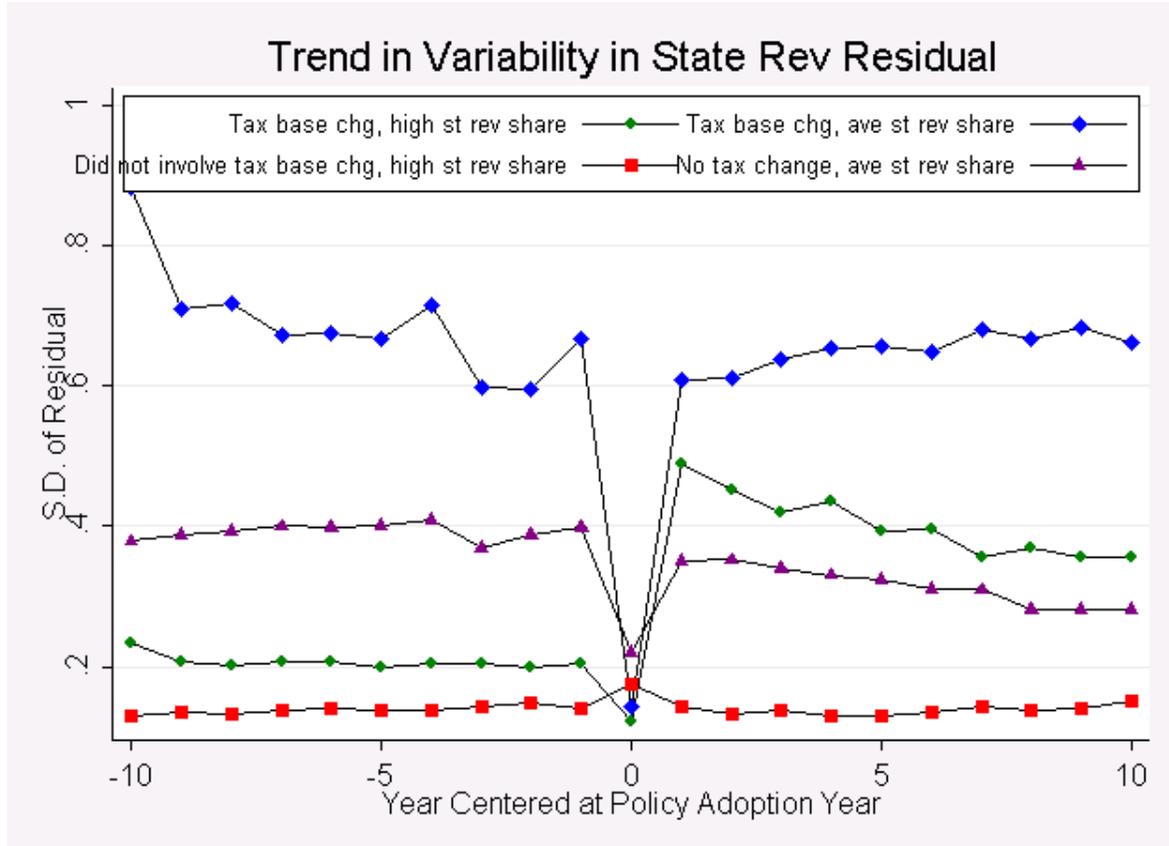
Figure B.3.

Trend in Variability in State Rev Residual

Legend:
- Tax base chg, high st rev share
- Tax base chg, ave st rev share
- Did not involve tax base chg, high st rev share
- No tax change, ave st rev share

Y-axis: S.D. of Residual

X-axis: Year Centered at Policy Adoption Year

Figure B.4. Model-based graph of before and after trend in revenue instability for states that equalized.

Trend in St Revenue Variab for States that Equalized

- Mean variability
- - - Pre-reform
· · · Post-reform

Year Centered at Each State's Reform Date

quadratic in reform trend, s.e's clustered at district level
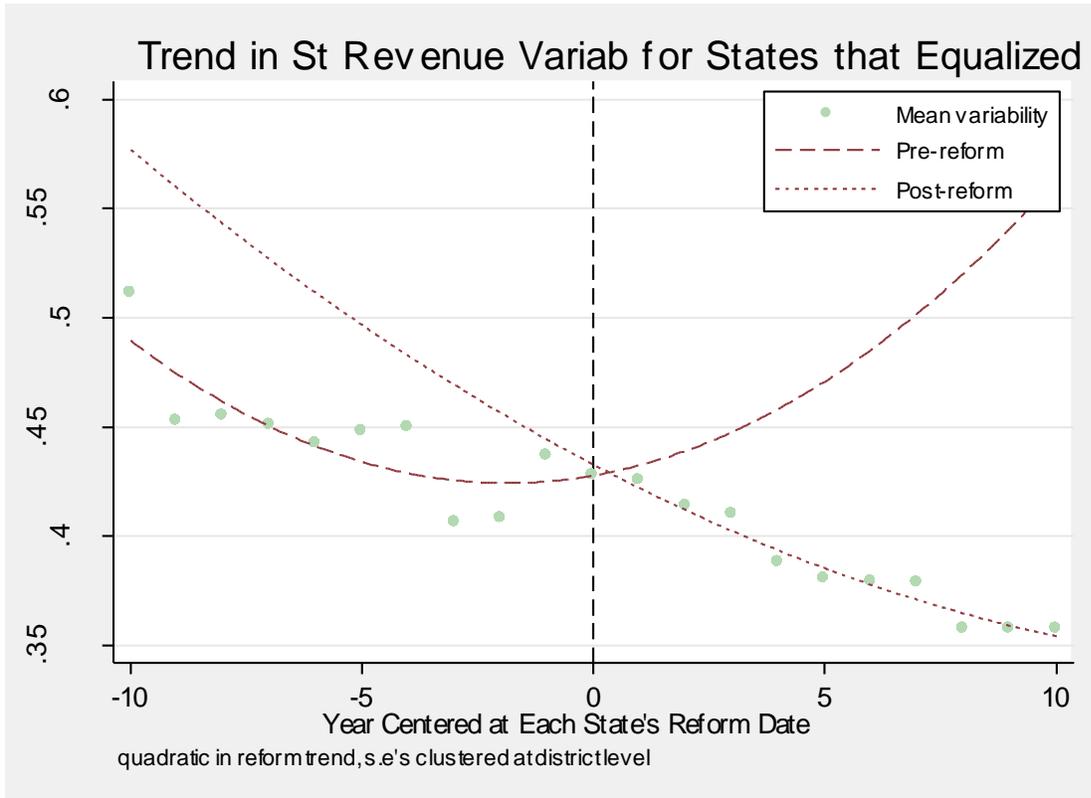
[i] Personal communication with 15 school district chief budget officers during February 2010.